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August 3, 2017

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: Ligado Networks LLC
IB Docket Nos. 11-109, 12-340; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091

Dear Ms. Dortch:

Iridium Communications, Inc. ("Iridium") hereby responds to the numerous factually, technically, and legally incorrect statements contained in the June 5 *ex parte* filing submitted by Ligado Networks LLC ("Ligado").[1] The June filing was Ligado's latest attempt to sweep aside the well-founded and legitimate interference concerns of Iridium and numerous other parties who continue to sound the alarm over the harmful effects of Ligado's proposal.[2] As nearly two dozen associations, academics, and companies recently informed the Federal Communications Commission ("FCC" or "Commission"), Ligado's proposed terrestrial operations "continue to pose a significant interference risk to numerous parties that receive real-time weather and related environmental information from the National Oceanic and Atmospheric Administration ("NOAA"), certified GPS receivers and aeronautical safety SATCOM relied upon by the aviation industry, and Iridium's 913,000 government and commercial subscribers."[3]

In response to Ligado's June 5 *ex parte* letter, Iridium emphasizes that: (1) Ligado's proposed terrestrial wireless operations pose a far greater interference concern in the band adjacent to Iridium's 1617.775-1626.5 MHz spectrum than current and future satellite operations

[1] Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109; RM-11681, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 (filed June 5, 2017) ("June 5 Ligado letter").

[2] *See, e.g.*, Letter from Coalition of Aviation, SATCOM, and Weather Information Users to The Honorable Ajit Pai, Chairman, FCC, IB Docket No. 11-109; RM-11681; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091 (filed June 27, 2017).

[3] *Id.* at 1.

in the same spectrum, and (2) while Ligado suggests that Iridium is trying to "relitigate" the *2003 ATC Order*, in reality, it is Ligado that has been steadily chipping away at the Order's requirements to the point that its current plan looks nothing like what the FCC envisioned when establishing the ancillary terrestrial component ("ATC") rules.[4] Iridium's technical concerns have been well-documented and are consistent with, and supported by, FCC precedent and other relevant federal government technical working groups. Far from being concerned about any competitive threat as suggested by Ligado, Iridium objects to Ligado's proposal because of the potential for significant harmful interference to Iridium's operations in violation of the FCC's rules if Ligado is permitted to deploy a terrestrial service in the adjacent frequency band as currently proposed.

A. Terrestrial Operations in the Spectrum Band Adjacent to Iridium Pose a Far Greater Interference Risk than Satellite Communications in the Same Band

In its June 5 *ex parte*, Ligado claims that Iridium is "attempting to relitigate the FCC's *2003 ATC Order*" and challenges Iridium's interference claims on the grounds that "Iridium is able to operate effectively today in the face of existing interference that is *far greater* than any interference Iridium would experience from Ligado ATC operations."[5] Both of these claims suffer from the same fundamental flaw – Ligado's refusal to acknowledge that the 4G or 5G terrestrial wireless business model they have chosen to pursue is fundamentally different from the facts in 2003 and what the Commission envisioned and approved when establishing ancillary terrestrial component ("ATC") rules.[6]

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[4] *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2050 ¶ 178 (2003) ("*2003 ATC Order*").

[5] June 5 Ligado letter at 16.

[6] Iridium notes that it is difficult to pinpoint the exact business model Ligado envisions given the many changes in form, name, and technical choices the company has made. Given their past instability, it is particularly important for the FCC to fully understand Ligado's current and planned or potential operations of the spectrum, and the potential for interference from such operations, before granting Ligado's modification request. Ligado's (LightSquared at the time) publicly stated business plan in 2011 was to sell service wholesale to cellular providers with plans to cover 92% of the United States and serve 100 million users (which would require Ligado base stations every 400 to 800 meters in densely populated areas, supporting up to 1200 users per station). Cecilia Kang, *Harbinger-Skyterra Ink $7 billion deal with Nokia to build 4G LTE satellite mobile broadband network*, Wash. Post, July 20, 2010. Its current business plan is now apparently to focus on "machine-to-machine (M2M) communications for critical vertical industry sectors in transportation, energy, electric utility, and for public safety." June 5 Ligado letter at 3. While Ligado is currently portraying itself as a hybrid satellite-terrestrial IoT service provider, a recently released Ligado-commissioned economic analysis suggests that Ligado seeks the

1. Interference Caused By Ligado Terrestrial Operations is Distinct from, And A Far Greater Threat to Iridium, Than Interference Caused By MSS Operations

Ligado continues to ignore the fundamental differences between satellite and terrestrial wireless broadband operations, and the dramatically increased likelihood of Iridium devices coming into contact with Ligado (or Ligado successor) terrestrial devices. What Ligado is proposing—the deployment of terrestrial 4G LTE and 5G operations using omnidirectional antennas with vastly different uses and devices, and the potential for tens of millions of such devices, many of which are virtually guaranteed to come into contact with Iridium terminals—is vastly different from Iridium's current operating environment. In every regulatory and technical venue, Ligado refuses to acknowledge the central importance of density in assessing the likelihood that it will cause interference to Iridium compared to the world in which Ligado seeks to force its spectrum neighbors to live.

Iridium explained in detail in its September 1, 2016 Technical Analysis why the harm from Ligado's potential interference is distinct from, and of greater concern than, interference from other MSS provider interference.[7] Given the importance of the issue, we summarize it again here. Basic spectrum management principles dictate that like services should be adjacent to other services with similar characteristics.[8] For over twenty years, because satellite services have been allocated spectrum in adjacent bands with established rules to ensure the coexistence of multiple satellite providers, Iridium's system is designed to receive and withstand some level of interference from other satellite systems that share the band or reside in adjacent bands. The Commission's allocations to Iridium's MSS neighbors (*i.e.* Globalstar, Inmarsat, Thuraya, and Ligado) were made with the assumption that MSS systems could successfully coexist – and they have.

MSS systems and terrestrial mobile systems have contrasting consumer markets and user profiles and the markets and profiles for both have changed significantly over the past decade. Terrestrial mobile networks have expanded their coverage areas and have matured through

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ability to sell its spectrum to the highest bidder, underscoring the uncertainty of any future use of the spectrum and why Iridium must continue to assume that the spectrum will be used to support a commercial terrestrial wireless network. *See Harold Furtchgott-Roth, Economic Analysis of the Ligado Petitions to the Federal Communications Commission Regarding Spectrum Flexibility and Spectrum Allocations (*filed as ex parte presentation in IB Docket No. 11-109; RM-11681; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091 (filed May 25, 2017).

[7] Iridium Communications Inc., Technical Analysis of Ligado Interference Impact on Iridium User Links, IB Docket Nos. 11-109 and 12-340 (filed Sept. 1, 2016).

[8] *See id.* at 2.

multiple generations of user access technologies (*e.g.* LTE) that support vastly greater capacities. The deployment of high-capacity 5G networks will further expand and densify terrestrial networks, enabling the use of a substantially greater number of devices.

Likewise, Iridium's use of its spectrum has evolved and grown significantly since the system was launched in the late 1990s as a voice-only system. Over the past two decades, Iridium has invested billions of dollars in its business, creating jobs, saving lives, and continuing to innovate to improve the system's capabilities for government and commercial users alike. This includes a $3 billion investment in the Iridium NEXT system. Iridium currently supports 913,000 subscribers, many of them using data messaging services. These data services are leveraged by machine-to-machine ("M2M") markets, supervisory control and data acquisition ("SCADA") applications, and personal, asset and vehicle/aircraft tracking applications. The Iridium network currently supports millions of these transactions on a daily basis, resulting in Iridium devices being deployed virtually everywhere throughout the United States, including densely populated areas. These services and user growth trends will continue to expand with the launch of Iridium NEXT, which will support all legacy services and user equipment while also delivering higher data rate services to meet increasing throughput demands.

To be sure, Iridium does currently receive some interference from Globalstar and Inmarsat MSS systems within the United States. Iridium and Globalstar are co-primary MSS sharers within the Big LEO band and, as such, are expected to accept limited amounts of interference from each other. These interference levels are largely manageable due to the low probability of dense numbers of Iridium and Globalstar user terminals being co-located in a small area. Inmarsat presents a different interference issue for Iridium. Many Inmarsat terminals produce out-of-band-emission ("OOBE") levels that produce interference to Iridium user terminals when those terminals are co-located. However, most of these Inmarsat terminals have directional (*i.e.*, not omnidirectional antennas that are used in LTE devices) which make coexistence with Inmarsat terminals more manageable. Furthermore, there are only several hundred thousand Inmarsat terminals worldwide, which provide generally similar services to Iridium, significantly decreasing the likelihood of large concentrations of Inmarsat and Iridium terminals coming into close proximity.

Compare this to the high likelihood of Iridium terminals and LTE devices being in the same geographic area if Ligado's (or a Ligado successor's) commercial terrestrial wireless network is deployed. A Ligado LTE device and an Iridium MSS terminal will provide very different services. Whereas the same user is not likely to have multiple MSS devices, it is very likely that they would simultaneously use an LTE and an MSS device. Thus, as a result of different use cases and sheer numbers of LTE devices, the risk of interference is dramatically greater than the interference Iridium experiences in its current spectrum neighborhood. Ligado's filings simply ignore these crucial differences.

2. It Is Ligado, Not Iridium, That Has Been "Relitigating" the 2003 ATC Order for Many Years

The FCC adopted the *2003 ATC Order* and created ATC primarily to assist MSS providers in increasing service coverage in urban areas and inside buildings where satellite systems at the time were ill-equipped to reach.[9] The establishment of the ATC service came with the explicit expectation, and requirement, that the terrestrial portion of the service would remain *ancillary* to the satellite operations and not cause harmful interference to MSS operations. Since then, Ligado has continually pushed to remove the "ancillary" nature of its proposed services, thereby increasing the likelihood of substantial interference to its spectrum neighbors, and its own MSS operations as Iridium has previously described.[10]

Since Ligado has suggested that Iridium is seeking to relitigate the *2003 ATC Order*, when in fact it is Ligado (and its many predecessors) that has relitigated the Order, it is appropriate to recall why the ATC were established and why so many protections were put in place to ensure the service remained *ancillary* to MSS. This history conclusively demonstrates that it is Ligado's proposal that would thwart the purposes of the Commission's ATC rules.

In March of 2001, the Commission received two separate proposals that held the potential to dramatically alter the course of the MSS industry.[11] The proposals, filed by New ICO Global Communications (Holdings) Ltd. ("ICO") and Mobile Satellite Ventures Subsidiary LLC ("MSV"), both of whom were MSS providers at the time, sought greater flexibility in the delivery of communications by MSS providers.[12] Although conceptually different in their technical approaches, both proposals requested that the Commission allow MSS providers the flexibility to integrate ancillary terrestrial components into their satellite networks by re-using their assigned MSS frequencies.[13]

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[9] *2003 ATC Order*, 18 FCC Rcd at 2050 ¶ 178.

[10] Letter from Bryan N. Tramont and Patrick R. Halley, Counsel for Iridium, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109 and 12-340, at 10 (filed Mar. 27, 2017) ("Iridium March 27 ex parte").

[11] Ex parte letter from Lawrence H. Williams and Suzanne Hutchings, New ICO Global Communications (Holdings) Ltd., to Chairman Michael K. Powell, FCC, IB Docket No. 99-81 (Mar. 8, 2001) ("ICO Letter"); Application filed by Motient Services Inc. and Mobile Satellite Ventures Subsidiary LLC for Assignment of Licenses and for Authority to Launch and Operate a Next-Generation Mobile Satellite Service System (Mar. 1, 2001) ("MSV Application").

[12] *Id.*

[13] *Id.*

At their core, the proposals were aimed at providing better coverage in areas that MSS providers could not otherwise serve.[14] These issues were especially pertinent in urban areas and inside buildings.[15] Although MSS systems offered, and continue to offer, a number of advantages over other communications services, a disadvantage of MSS technology at that time was the fact that MSS links were susceptible to blocking in urban areas and inside buildings.[16] According to MSV and ICO, permitting MSS providers to integrate terrestrial services within their MSS networks would enable MSS providers to overcome these technical difficulties.[17]

In 2003, less than two years after receiving these proposals, the Commission adopted the *ATC Order* permitting MSS operators to integrate ATC into their MSS systems.[18] In adopting the new rules, the Commission cited a long list of public interest benefits that would likely be realized by the integration of ATC into MSS networks, all of which related to the importance of allowing MSS operators to use their existing spectrum allocation to fill gaps in their existing coverage.[19] In its comments in the ATC proceeding, Iridium cautioned the Commission that while "[t]here is no question that terrestrial operations in the MSS bands – coordinated with satellite operations – are technically feasible; the issue is whether they can be conducted on an economically viable basis without threatening, through interference, the viability of the satellite services."[20] Noting the important role of satellite service, the Commission adopted "gating criteria" that an ATC applicant must meet to ensure that ATC would remain ancillary to the provision of MSS.[21] The gating criteria includes: (1) MSS coverage requirements; (2) a

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[14] *Id.*, *see also*, *e.g.*, *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Notice of Proposed Rulemaking, 16 FCC Rcd 15532, 15532-33 ¶ 1 (2001) ("*Flexibility Notice*") ("two MSS operators have made proposals to the Commission to integrate terrestrial services with their networks, using assigned MSS frequencies to augments signals where the satellite signal is attenuated, particularly in urban areas and inside buildings.")

[15] *See, e.g.*, *Flexibility Notice*, 16 FCC Rcd at 15532-33 ¶ 1.

[16] *See*, *e.g.*, *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Memorandum Opinion and Order and Second Order on Reconsideration, 20 FCC Rcd 4616, 4618 ¶ 7 (2005) ("*MSS/ATC Second Reconsideration Order*") ("A disadvantage of MSS is the fact that the satellite link is susceptible to blocking by structural attenuation, particularly in urban areas and inside buildings.")

[17] *See* ICO Letter; MSV Application.

[18] *See 2003 ATC Order*.

[19] *Id.* at 1973 ¶ 18.

[20] Comments of Iridium Satellite LLC in Response to Public Notice of March 6, 2002, IB Docket No. 01-185; ET Docket No. 95-18 (filed Mar. 22, 2002).

[21] *See 2003 ATC Order*, 18 FCC Rcd at 1999-2013 ¶¶ 66-93.

requirement to maintain a ground spare satellite within one year of commencing ATC operations; (3) a requirement to maintain commercial availability of MSS service; (4) a requirement to operate ATC in the same band as the applicant's MSS operations; and (5) a requirement to offer an integrated MSS/ATC service, which could be met through a safe harbor showing that all handsets offered by the operator were dual-mode (MSS and ATC). The Commission stressed the importance of satisfying all of these criteria, noting that it viewed "full and complete compliance with each of these requirements as essential to the integrity of our 'ancillary' licensing regime."[22] The Commission concluded in the *2005 ATC Second Reconsideration Order* that "[t]o the extent we receive specific complaints about a particular system, we will examine the totality of the services being offered *to ensure that the terrestrial service is in fact ancillary to the satellite service*."[23]

The Commission also adopted technical rules to mitigate the potential for harmful interference resulting from ATC operations.[24] The Commission expressed confidence that the rules, which were "designed to protect adjacent and in-band operations from interference from ATC," would be "sufficient" for preventing such interference.[25] However, "in the unlikely event" of "harmful interference from ATC operations," the Commission placed the onus on the ATC operator to "resolve such interference."[26] The Commission codified this protection in its rules,[27] and explained later that the rule imposes an "absolute obligation on the MSS/ATC operator to resolve any harmful interference to other services."[28]

If Ligado were to operate under its initial authorization, its operations would be ancillary to its satellite operations and subject to the following requirements: (1) a limit on the deployment base stations to no more than 1,725 per channel;[29] (2) standoff distances and PFD limits to

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[22] *Id.* at 1999-2000 ¶ 66.

[23] *MSS/ATC Second Reconsideration Order*, 20 FCC Rcd at 4625 ¶ 23 (emphasis added).

[24] *See*, *e.g.*, *2003 ATC Order*, 18 FCC Rcd at 2017 ¶ 104 ("We adopt technical parameters for ATC operations in each of the bands at issue designed to protect adjacent and in-band operations from interference from ATC.").

[25] *Id.*

[26] *Id.*

[27] *See* 47 C.F.R. § 25.255.

[28] *Spectrum & Service Rules for Ancillary Terrestrial Components in the 1.6/2.4 GHz Big LEO Bands*; *Globalstar Licensee LLC, Auth. to Implement an Ancillary Terrestrial Component*, Report & Order and Order Proposing Modification, 23 FCC Rcd 7210, 7223 ¶ 35 (2008).

[29] *2003 ATC Order*, 18 FCC Rcd at 2036 ¶ 142.

minimize the deployment of ATC near airports and waterways;[30] (3) a terrestrial component that is integrated with the satellite offering so that ATC would only operate in areas where the satellite signal is attenuated with the satellite path being the preferred communications link;[31] and (4) technical requirements for ATC handsets that protect co-frequency and adjacent frequency satellite operations, including EIRP out-of-band emissions and requiring an MSS licensee to reserve a minimum of 10 dB in its link budget for power control within the ATC network.[32]

However, starting in 2003, with its first application for ATC authority, Ligado began seeking waivers of the ATC gating other technical requirements. At that time MSV, one of Ligado's predecessors, requested a waiver of the spare satellite gating requirement and many of the FCC's technical rules and a certification that the company would comply with the dual-mode handset gating requirement.[33] The Bureau concluded that Ligado's proposed dual-mode handsets would meet the safe harbor showing to satisfy the "integrated service" gating criterion and granted many of the technical waivers requested by Ligado.[34] While the Bureau denied Ligado's request for waiver of the "spare satellite" gating criterion,[35] it granted Ligado's ATC application in 2004. Ligado sought to modify that grant with a renewed request for waiver of the "spare satellite" gating criterion in 2007, and the FCC granted the waiver later that year.[36]

In 2009, Ligado filed another application seeking additional waivers of technical rules governing its ATC authority.[37] These waiver requests sought permission for Ligado "to deploy

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[30] *2003 ATC Order*, 18 FCC Rcd at 2040 ¶ 154. The FCC created these limits to protect Inmarsat but Iridium would benefit from these limits due to increased separation distances. These limits were removed or relaxed in 2005. *MSS/ATC Second Reconsideration Order*, 20 FCC Rcd at 4640 ¶ 65.

[31] *2003 ATC Order*, 18 FCC Rcd at 2030 ¶ 129.

[32] *Id.* at 2036 ¶ 142.

[33] *See, e.g., Mobile Satellite Ventures Subsidiary LLC Application for Minor Modifications of Space Station License for AMSC-1*, Order and Authorization, 19 FCC Rcd 22144, 22146-47 ¶ 7 (IB 2004) noting that "MSV contended that grant of the application and the associated waiver requests would enable it, for the first time, to offer a ubiquitous, high-quality, integrated mobile service throughout the United States." MSV Application for Minor Modification and Amendment (filed Nov. 18, 2003).

[34] *Id.*

[35] *Id.* at 22152 ¶ 24.

[36] *Mobile Satellite Ventures Subsidiary LLC, Applications for Limited Waiver of On-Ground Spare Satellite Rule*, 22 FCC Rcd 20548 (IB 2007).

[37] Mobile Satellite Ventures Subsidiary LLC Application for Minor Modification of Space Station License (AMSC- 1) Modification and Request for Expedited Consideration, IBFS File No. SAT-MOD-20090429-00047 (Apr. 29, 2009).

an integrated terrestrial component that [was] more robust and ha[d] greater capacity than [was] permitted by the existing interference-related technical rules."[38] In response to this application, the GPS community raised concerns about the potential for harmful interference to GPS operations in bands adjacent to Ligado's ATC operations.[39] Ligado was forced to modify its waiver requests, and in March of 2010, the Bureau adopted an order granting the substantial majority of Ligado's requested technical modifications.[40]

In November 2010, Ligado submitted yet another filing regarding the Commission's "integrated service" gating criteria.[41] In this filing, Ligado notified the Commission that its business plans had "evolved" since it had certified in its ATC application that its handsets would meet the dual model safe harbor, and that it now planned to offer terrestrial-only handsets for operation on its ATC network.[42] Nonetheless, Ligado asserted that its planned offering still satisfied the "integrated service" gating criterion because its "network is integrated," its "pricing is integrated," and it is capable offering "dual-mode devices."[43] However, Ligado requested a waiver if the Commission determined that one was required.[44]

In January 2011, the Bureau concluded that Ligado did not satisfy the "integrated service" criterion, but found good cause for the grant of a conditional waiver.[45] However, the waiver of the "integrated service" gating criterion was conditioned upon, among other things, Ligado resolving new harmful interference concerns recently raised by federal and non-federal users of GPS devices, including NTIA.[46] To satisfactorily resolve this interference, the *Conditional Waiver Order* established a multi-stakeholder working group to fully study the

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[38] *Id.*

[39] *See* Comments of the U.S. GPS Industry Council, IBFS File No. SAT-MOD-20090429-00047 (filed July 10, 2009).

[40] *See SkyTerra Subsidiary LLC Application for Modification Authority for an Ancillary Terrestrial Component*, Order and Authorization, 25 FCC Rcd 3043 (IB 2010).

[41] *See* Letter from Jeffrey J. Carlisle, Executive Vice President for Regulatory Affairs & Public Policy, LightSquared, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239 (filed Nov. 18, 2010).

[42] *Id.*

[43] *Id.* at 10.

[44] *See id*.

[45] LightSquared Subsidiary LLC, Order and Authorization, 26 FCC Rcd 566 (IB 2011) ("*Conditional Waiver Order*").

[46] *Id.*; *see also* Letter from Lawrence E. Strickling, Assistant Secretary for Communications and Information, U.S. Department of Commerce, to Julius Genachowski, Chairman, FCC (filed Jan. 12, 2011).

potential for interference to GPS devices.[47] The *Conditional Waiver Order* established that the interference concerns must be resolved to the Commission's satisfaction before Ligado could commence offering commercial terrestrial services.[48]

Upon completion of the testing, which identified the existence of harmful interference, Ligado submitted recommendations to address those interference concerns."[49] Consequently, a second round of testing was conducted that yielded interference concerns as well,[50] and NTIA sent a second letter to the FCC in February 2012 concluding that "there [was] no practical way to mitigate the potential interference" posed by Ligado's proposed ATC network.[51] The following day the FCC's International Bureau issued a Public Notice seeking comment on, among other things, whether it should "suspend indefinitely Ligado's] underlying ATC authorization…."[52] Later that spring, the company filed for bankruptcy protection. In December 2015, Ligado filed the applications for terrestrial wireless broadband service that are at issue today.[53]

This lengthy history illustrates Ligado's systematic effort to relitigate the *2003 ATC Order* by seeking waivers to the Orders rules and increasing threats of interference to operators in adjacent bands. In yet another affront to the *2003 ATC Order*, Ligado continues to downplay the significance of that Order's adoption of section 25.255 of the Commission's rules which requires ATC operators to resolve harmful interference caused "either from ATC base stations or

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[47] *Conditional Waiver Order*, 26 FCC Rcd at 586 ¶ 41 ("we believe that establishing a working group that brings LightSquared and the GPS community together to address these interference issues expeditiously would serve the public interest.").

[48] *Id.* at 585-86 ¶ 40.

[49] *See* Letter from Henry Goldberg, Counsel for LightSquared Subsidiary LLC, Goldberg, Godles, Wiener & Wright, to Marlene H. Dortch, Secretary, FCC (filed June 30, 2011); *see also* Technical Working Group Report, Final Report, IBFS File No. SAT-MOD-20101118-00239 (filed June 30, 2011).

[50] Letter from Ashton B. Carter, PNT ExCom Co-Chair, Deputy Sec'y, U.S. Dep't of Defense & John Porcari, PNT ExCom Co-Chair, Deputy Sec'y, U.S. Dep't of Transp., to Lawrence E. Strickling, Assistant Sec'y for Commc'n and Info., U.S. Dep't of Commerce (filed Jan. 13, 2012) ("It is was the unanimous conclusion of the test findings . . . that both LightSquared's original and modified plans for its proposed mobile network would cause harmful interference to many GPS receivers.").

[51] Letter from Lawrence E. Strickling, Assistant Sec'y for Commc'n and Info., U.S. Dep't of Commerce, to Julius Genachowski, Chairman, FCC (filed Feb. 14, 2012).

[52] *See International Bureau Invites Comments on NTIA Letter Regarding LightSquared Conditional Waiver*, Public Notice, IB Docket No. 11-109 (rel. Feb. 15, 2012).

[53] Applications of LightSquared Subsidiary LLC, Narrative, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231- 00091, and SES-MOD-20151231-00981 ("2015 Ligado Applications").

mobile terminals" to MSS or other operators.[54] Iridium will not repeat its arguments here as it has already discussed the applicability of Section 25.255 at length.[55] In 2003, the FCC envisioned interference as an "unlikely event" due to the many gating requirements and technical rules it established to ensure that ATC remained an *ancillary* service.[56] However, given the number of ATC gating and technical requirements that have been waived combined with the number of parties who have raised concerns about the detrimental impact Ligado's proposed operations could have in its frequency neighborhood, the interference risk has become more than a likely event and Section 25.255 has proven to be a critical component of the *2003 ATC Order*.

Ligado's proposed operations look nothing like the ATC service envisioned by the Commission in 2003 – and Ligado's rhetoric about Iridium relitigating the 2003 *ATC Order* is astonishing. Ligado has methodically sought to chip away at the FCC's ATC gating and technical requirements with the goal of effectively reallocating its spectrum licenses from satellite to terrestrial. Meanwhile its satellite business has withered and its abundant spectrum resources have largely remained fallow.[57] Along the way, the company has recruited an army of lobbyists and has entered into a series of costly settlements and back room deals to grease its proposals. The company's playbook should be seen for what it is – pure spectrum arbitrage. Moreover, while Ligado has shown an increasing disinterest in its satellite service,[58] and has yet to explain how its terrestrial service will not self-interfere with its own satellite terminals, Iridium remains fully committed to operating its successful and growing *satellite* business in its satellite band. ATC was never designed to undermine successful satellite operations in a satellite band – and Ligado's efforts to twist ATC to that result should not be rewarded.

In contrast Iridium has spent the last two decades building a business with more than 900,000 commercial and government subscribers by efficiently using less than nine total megahertz of spectrum for its uplink and downlink operations. Based on its proven track record of success, the company is in the process of upgrading its system through the launch of the $3

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[54] 47 C.F.R. § 25.255.

[55] Iridium March 27 ex parte at 14; Letter from Bryan N. Tramont and Patrick R. Halley, Counsel for Iridium, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109 and 12-340, at 10 (filed Dec. 14, 2016) ("Iridium December 2016 ex parte").

[56] *2003 ATC Order*, 18 FCC Rcd at 2017 ¶ 104.

[57] *See e.g.* Iridium March 27 ex parte at 3, 10.

[58] Ligado Networks Subsidiary LLC, Application to extend MSAT-2 license term through 2017, IBFS File No. SAT-MOD-20180112-00003 (filed Jan 12, 2017) ("Ligado Mod"). Ligado concurrently filed a STA to continue providing service while the application to extend its license is pending. Ligado Networks Subsidiary LLC, Request for Special Temporary Authority, IBFS File No. SAT-STA-20170112-00004, Call Sign AMSC-1 (filed Jan. 12, 2017). The International Bureau granted the 60-day STA request on January 18, 2017.

billion Iridium NEXT system.[59] Iridium has been able to achieve its success by designing its system and establishing effective working relationships with its *satellite* neighbors. Ligado, a company that, in its current form, seeks approval to apparently operate a hybrid terrestrial-satellite "internet of things" business using 40 MHz of spectrum (without ever demonstrating why it needs such a vast amount of spectrum for such a business model) would be better served by learning from Iridium's spectrum efficiency rather than criticizing it. Likewise, Ligado has touted the $800 million in proposed investment that its planned terrestrial wireless broadband operations could bring, a far cry from the comparatively immense investment that Iridium has already made and the business it has built in its 8.725 MHz of spectrum.

B. Iridium's Technical Analysis Demonstrating Potential Harmful Interference Is Supported by FCC Precedent and Other Federal Government Working Groups

Finally, Ligado claims that Iridium has been unrealistic in providing "worst-case analysis to inflate the interference risk posed to Iridium by Ligado's proposed ATC operations," as a result of Iridium being "blind to basic, well-accepted characteristics of LTE technology."[60] That is incorrect. In reality, Iridium has used LTE parameters that have been accepted in multiple previous assessments of interference, including those which included extensive Ligado participation. In fact, the only "LTE technology" parameter that Ligado has previously taken issue with in Iridium's analyses has been the application of power control to reduce Ligado user terminal emissions. Iridium fully understands that mobile wireless communications systems employ power control that reduces *in*-band emissions. At issue here is the applicability of power control to reducing *out*-of-band emissions and Iridium's analysis is based on the guidelines provided in other Ligado interference assessments in this regard.

Indeed, Iridium is not aware of any industry or government body that has analyzed the impact of Ligado interference in which power control was applied to Ligado user terminal OOBE. In some cases, power-controlled reductions of in-band power levels were used, but were specifically not applied to OOBE.[61] In other cases, power-controlled levels were not applied to

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[59] Press Release, Iridium, *SpaceX Second Launch Doubles the Number of Iridium® NEXT Satellites in Space*, Globe Newswire, June 25, 2017; John Antczak and Christopher Weber, Associated Press, *SpaceX Launches 10 Satellites from California Air Base*, Bloomberg, June 25, 2017.

[60] June 5 Ligado letter at 15.

[61] *See* Commerce Spectrum Management Advisory Committee Working Group 1, Final Report: 1695-1710 MHz Meteorological-Satellite, Rev. 1, App. 3 - 5 (July 23, 2013) ("Meteorological-Satellite Report"), https://www.ntia.doc.gov/files/ntia/publications/wg1_report_07232013.pdf, "OOB specification is defined with respect to the edge of the occupied bandwidth and it is absolute value", and "the UE OOB emissions are modeled as a constant level below 1695 MHz referenced to a measurement bandwidth of 1 MHz," Appendix at 7-8. *See also* RTCA Special Committee 159, Assessment of the Lightsquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne

in-band emissions because the particular group studying the impacts of Ligado interference deemed it necessary to look at near worst case scenarios.[62] In fact, the FCC's GPS Technical Working Group stated, "[t]he major disadvantage or concern is that field testing uses the present environment, not the environment that might exist at some future or past time. Interference testing analysis has to consider worse case assumptions, and not only the current test reality."[63] We also note that Ligado's own December 2015 Application clearly states that the LTE user terminal OOBE levels are specified in absolute values.[64]

With respect to Ligado LTE user density, the other main relevant "LTE technology" parameter used in Iridium's interference assessments, Iridium has used an extremely conservative value of 18 simultaneous users per LTE cell (6 users per sector) that does not remotely represent a "worst case" scenario, given that LTE can support hundreds of users per cell.[65] As Iridium has noted in past filings, its assumptions are consistent with the work of CSMAC WG-1, which provided a "typical value of 18 simultaneous users per LTE cell (*base station)."[66] Contrary to Ligado's allegations, Iridium has worked with existing industry-accepted parameters to conduct its analysis to determine the potential for interference risk into Iridium's satellite operations.

* * *

Ligado's proposal contravenes the letter and intent of the FCC's *2003 ATC Order* which Ligado has been steadily eroding with each successive application to remove the "*ancillary*" from ATC. The Commission's rules are clear that Ligado must resolve harmful interference caused either from ATC base stations or mobile terminals to MSS or other operators. Iridium's well-founded engineering analysis demonstrates that Ligado's proposed terrestrial wireless broadband operations in the 1627.5-1637.5 MHz band will cause harmful interference to

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Receiver Operations 17, at 14 (2011) ("SC-159 Assessment"), "However, since the RFI effect on the GPS receiver is from UE unwanted emissions more than 52 MHz below the UE carrier, the assumed unwanted EIRP value for analysis in this report is the OOBE limit independent of power control."

[62] *See e.g.*, National Advanced Spectrum and Communications Test Network, *AWS-3 Out of Band Emissions Measurements Test and Metrology Phase II Test Plan* (Oct. 11, 2016); NIST Technical Note 1952, *LTE Impacts on GPS Final Report* (Feb. 2017).

[63] Letter from Henry Goldberg, Counsel for LightSquared Subsidiary LLC, to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-MOD-20101118-00239, at 4 (filed Mar. 15, 2011).

[64] *See* 2015 Ligado Applications.

[65] Iridium Technical Analysis of Ligado Interference Impact on Iridium Aviation Services, at 5 (citing Meteorological-Satellite Report, at App. 3 – 4) (attached to Iridium December 2016 ex parte).

[66] Iridium December 2016 ex parte at 2.

Iridium's operations in the adjacent band. There are fundamental differences between satellite and terrestrial broadband operations and there is a dramatically increased likelihood of Iridium devices coming into contact with Ligado (or Ligado successor) terrestrial devices. As a result, interference from Ligado terrestrial operations will greatly surpass any interference that would be caused by current and future satellite operations in the same band, an outcome the Commission cannot permit.

Please contact the undersigned with any questions.

Sincerely,

/s/ Bryan N. Tramont

Bryan N. Tramont
Patrick R. Halley